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EIGEN-SENSITIVITY BASED METHOD FOR STATISTICAL ENERGY ANALYSIS PARAMETERS IDENTIFICATION USING TRANSIENT MEASURED DATA

Abstract

The Statistical Energy Analysis (SEA), at present, has been widely recognized as an efficient analysis tool for the high frequency structural vibrations of space vehicles. The coefficients of the SEA equations depend on the coupling loss factor (CLF), the internal loss factor (ILF) and the modal density. For complex systems, the values of such SEA parameters cannot be provided by analytical relationships and it is rather necessary to determine them experimentally to provide a reliable solution. This paper proposes an experimental method based on eigen-sensitivity analysis for SEA parameters identification using transient measured data. The sensitivity formulas of eigenvalue and eigenvector of quasi-transient SEA are derived, which then provide reasonable search directions for iteratively adjusting the CLF and ILF. The objective of the method is to minimize the residuals between analytical and experimental eigen-parameters. The Levenberg-Marquardt algorithm is used during the adjust process to find a robust solution in the case that the sensitivity matrix tends to be ill-condition. And the experimental eigen-parameters of quasi-transient SEA are identified using subspace method in time domain from transient measured data. Both numerical and experimental examples are given to validate the proposed method. It is observed that a full measurement of input power and energy to every subsystem is not necessarily required for a successful identification, which indicates that the current method has the advantage over the traditional experiment technology that is power injection method (PIM). The proposed method can also provide a useful complement to experimental statistical energy analysis.